excellent monthly summaries of geographical news in this most important of geographical journals. Besides others, the number for November contains an article on the use of elephants in African exploration, written by Dr. Petermann shortly before his death, and one concerning D'Alberti's New Guinea Exploration, with a map of the Fly River.——The *Geographical Magazine* for November contains the best map of the seat of war in Afghanistan which has yet appeared, both as regards accuracy, fullness of information and excellence in the mechanical execution. With the December number this periodical ceased to be published, but is replaced by the *Proceedings of the Royal Geographical Society and Monthly Geographical Record*, under the charge of the Secretary of the Society, Mr. Clements R. Markham, who so ably conducted the magazine.——Several new geographical monthly periodicals have recently appeared in Europe. The *Deutsche Rundschau für Geographie und Statistik* is edited by Prof. Arendts, of Munich, and published by Hartleben, Vienna. *Aus fernen Zonen*, published by Mutze, Leipzig, is especially intended for the reception of communications from members of the various Christian missions in the less known portions of the globe; whilst from Paris the *Annales de l'Extrême Orient*, edited by Count Meyners d'Estrey, of the Indian press, expects to keep the scientific world informed of literary and geographical progress in Southern Asia, and especially in the Dutch Indies and in Dutch Oriental literature.——Dr. Nachtigal, the distinguished African traveler, has been elected President of the Berlin Geographical Society.——The *Athenæum* states that Mr. Johnson, the present Governor of Ladakh, when connected with the Indian Survey of 1865, ascended Peak E. 61 of the Kuen Lun range, whose height it now appears is no less than 23,890 feet! This is believed to be the greatest height above the level of the sea attained by any traveler on foot. The plains at the base of the Peak have probably an altitude of nearly 18,000 feet.

MICROSCOPY.[1]

REMOVAL OF AIR FROM MICROSCOPIC SPECIMENS.—Much difficulty has been experienced by the working microscopist in removing air from his specimens. If he wishes to mount wood-sections the difficulty is increased. Some may suppose that such an undertaking is physically impossible; for hitherto, in spite of all the pains and labor taken, unless by some lucky stroke, as it were, bubbles of air will still be left in the objects, and the slide becomes entirely worthless as a perfect specimen.

Various methods have been adopted to remove these bubbles of air, with greater or less success. One method has been to soak the specimens, after they have been cut, in different fluids for some length of time. The favorite fluids have been turpen-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

tine, oil of cloves and the like; these, however, give very unsatisfactory results. My friend, Dr. C. B. Johnson, of Providence, R. I., informs me that he has sections of wood which have been laying in oil of cloves for over three years, and from which the bubbles of air have not been at all removed. Perhaps the same may be said of the oleo-resins. Recourse has also been had to the air-pump; the idea being that an object placed beneath the bell glass, a few strokes of the piston will suck out all the air from it. But although in theory this seems plausible enough, yet as a perfect vacuum cannot be attained, some air, be it ever so small an amount, must render the objects of no use for microscopic examinations.

Thus have microscopists been at their wits' end to discover some process by which their object can be perfectly and satisfactorily accomplished. As no notice has been made of late of any new procedure in this direction, I think my friend, Dr. Johnson, who has had great success in mounting objects for the microscope, can justly be entitled to the first discovery of a mode for the removal of air, at once simple and effective. The apparatus he employs is of very simple construction, being a digester, or, as in his case, a common dentists' vulcanizer, the means—steam. The specimens to be thus treated, especially those of wood, are prepared in the usual way, and made ready for mounting. They are next placed in a small vessel of any material which will resist a certain amount of heat. Dr. Johnson uses a small glass phial in his experiments; this is filled up with water after all the specimens, as many as it can conveniently hold, are placed within. A cork can be used, but a slit must be cut in it to allow the escape of air and the admission of steam and hot water. A little water is now poured into the vulcanizer, the bottle of objects placed within and the lid of the machine screwed air tight. The whole is now heated to a temperature of about 300° Fahr. for a few minutes. This temperature is sufficient for all practical purposes; a higher degree of heat is unnecessary, or a longer time to remain at the given temperature needless.

When sufficiently cooled the phial is removed, the water drained from the bottle and alcohol substituted. The specimens are now ready for mounting, or can be bottled and set away indefinitely for use.

This constitutes the whole process; by it the specimens are *absolutely free* from air. Perfect satisfaction is guaranteed; and in every case we are absolutely sure of the results, provided of course that the proper care has been taken.

The *modus operandi* seems to be that the steam penetrates the pores of the wood or other substances, and forces out the air whose place it takes. The air is then absorbed by or dissolved in the surrounding medium. The woody fibres are not destroyed by the hot and compressed steam, except the soft tissues, as one would at first

sight suppose. They are entirely uninjured, and their purposes for microscopic study remain as good as by any other process. Tender specimens in every case must be tenderly treated. This mode of procedure has been followed by several microscopic friends in my vicinity for two or three years, and all the specimens so treated have been remarked for their beauty and excellence.—*F. C. Clark, Providence R. I.*

Limits of Accuracy in Measurements with the Microscope.—Before we can safely draw conclusions from a given series of measurements, it is necessary to know within what limits their errors can be determined. A simple and direct way to do this is to compare the measurements of the same space made by different observers and under entirely different conditions. I may get results which show an agreement, *inter se*, quite within the limits of the accuracy required, and which are yet wide of the truth. But if another observer obtains substantially the same results from a series of measurements made under entirely different conditions, the inference of their general correctness may be drawn with tolerable safety.

One must draw a sharp distinction between absolute accuracy and an appearance of accuracy. For example, the head of the screw of my dividing engine can be set to correspond to a motion of one billionth of an inch with entire certainty as far as the mechanical indications of this degree of accuracy are concerned, and yet previous to May, 1877, the actual errors of a given ruled plate amounted under certain conditions to $\frac{1}{7000}$ of an inch. Even now, after four epochs of improvement, I can hardly say of a given space that it is certainly true within $\frac{1}{80000}$ of an inch, until I have made a special investigation of it with my comparator.

In carrying forward this investigation I was fortunate in securing the coöperation of Prof. Edward W. Morley, of Hudson, Ohio, an observer who possesses in a high degree the three requisites, patience, care and skill. I ruled five plates of bands, plates No. 1 and No. 2, having spaces of $\frac{1}{600}$ and $\frac{1}{480}$ of an inch, respectively. These plates were ruled just as, I regret to say, all plates were ruled previous to May, 1877, without any attempt to correct the errors peculiar to the screw and its mounting. For four years previous to this date every effort was made to correct these errors by mechanical adjustments. After this date I deliberately abandoned all attempts to do this. Instead, I resolved to admit the existence of these errors, and after determining their value, I adopted a device for correcting them during the process of ruling. Plate No. 3 was ruled like No. 1, but with these systematic corrections applied. My next improvement consists in adopting a device for correcting not merely the systematic errors depending on one revolution of the screw, but also the errors peculiar to particular parts of the screw. Plate No. 4 consists of 101 lines separated by an interval of $\frac{1}{2400}$ of an inch, and freed as nearly as

possible from errors of all kinds. Plate No. 5 consists of 21 lines separated by an interval of $\frac{1}{20}$ mm. After careful measurement with two different micrometers and two comparators, the plates were sent to Prof. Morley, the details of whose measurements will be found in the forthcoming volume of the Proceedings of the American Academy of Arts and Sciences. The degree of agreement between his results and my own is much more perfect than I had anticipated before beginning this investigation.

From this investigation I think we may safely draw the following conclusions: (*a*.) Two equally skillful observers can measure the same space within about $\frac{1}{300000}$ of an inch if the space does not exceed $\frac{1}{500}$ of an inch. For a space of $\frac{1}{100}$ of an inch the deviation will probably amount to $\frac{1}{80000}$ of an inch in case the measurements are made with an eye piece or a filar micrometer. (*b*). The average deviation for accumulated errors under similar conditions is not far from $\frac{1}{50000}$ of an inch for eleven intervals. For a larger number of intervals the deviation will be somewhat larger, but it will not be in proportion to the number of intervals. (*c*). A single observer can obtain an agreement with a normal equation representing all the observed values as far as a solution by least squares can represent them, within somewhat smaller limits than those obtained by comparing the results obtained by two different observers.—*Wm. A. Rogers, Harvard College Observatory.* (*From a paper read at the National Microscopical Congress, August,* 1878.

THE SOCIETY SCREW.—At a recent meeting of the State Microscopical Society of Illinois, Mr. Bulloch urged the desirability of adopting a uniform objective screw of larger size than the society screw now in use, as being essential to the efficiency of low power lenses of high angle. That the society screw, which has now become an almost indispensable convenience, is too small to admit of efficient work from these lenses, is a conceded fact, and some makers in this country who make low powers of enormous angle have already adopted special screws for them. The uniformity urged by Mr. Bulloch is greatly to be desired, and could be easily attained if its importance were appreciated in time.

EXCHANGES.—Gatherings containing polycystina, etc., wanted in exchange. Address I. F. Stidham, Columbus, Ohio.

Western mosses, etc., for other species. George W. Worcester, West Side, Crawford Co., Ohio.

Diatomaceous earths and named diatoms for named diatoms or other good mounted objects. M. A. Booth, Longmeadow, Mass.

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SCIENTIFIC NEWS.

— The United States Entomological Commission, attached to the United States Geological and Geographical Survey of the